

## Surgical Case of Aortic Root and Thoracic Aortic Aneurysm after the Wheat Procedure

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**A 52 year-old man underwent aortic valve replacement and ascending aortic replacement (Wheat procedure) for acute dissection (Stanford type A) and aortic regurgitation (grade 3/4). At that time, the aortic root was slightly dilated at about 45 mm and the descending aorta was within a normal range at about 35 mm. Forty months after the initial operation, a follow-up chest enhanced computed tomography showed an aortic root aneurysm about 60 mm in diameter, a thoracic aortic aneurysm about 70 mm in diameter and chronic aortic dissection. First we performed the Bentall procedure, innominate artery and left common carotid artery replacement by 12 mm, and 10 mm Hemashield grafts during selective cerebral perfusion. After 10 weeks, we carried out aortic arch, descending aorta and left subclavian artery replacement. The postoperative course was uneventful and postoperative examination demonstrated a good surgical result. Histological findings of the aortic aneurysm wall showed cystic medial necrosis, but Marfan's syndrome was excluded clinically. We could diagnose aortic root aneurysm by regular follow-up chest enhanced computed tomography (CT) and echocardiography. Therefore, cases with slight dilation of the aortic root in the Wheat procedure should undergo regular follow-up evaluation by chest enhanced CT and echocardiography. (Ann Thorac Cardiovasc Surg 2002; 8: 115–8)**

**Key words:** aortic valve and ascending aorta replacement (Wheat procedure), aortic root aneurysm, Bentall procedure, cystic medial necrosis, reoperation

### Introduction

Surgical case reports of aortic root aneurysm after aortic valve replacement and ascending aortic replacement (Wheat procedure) are rare, but serious complications with the possibility of rupture. Recently some authors<sup>1-3)</sup> reported that aortic complication after aortic valve replacements are probably due to a pathological factor or Marfan's syndrome. However the surgical strategy and preoperative predictor of aortic complication remain unclear. We report a successful surgical repair of the aortic root aneurysm and the thoracic aortic aneurysm after

Wheat procedure. Histological findings of the aortic wall of the aneurysm showed cystic medial necrosis, but Marfan's syndrome was excluded clinically.

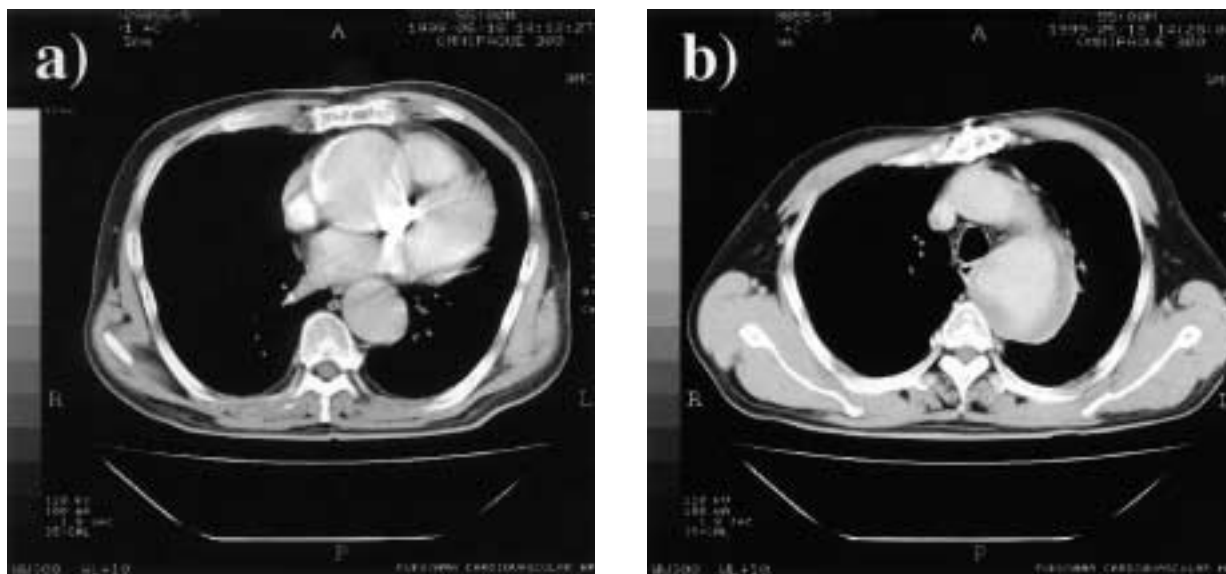
### Case

A 52-year-old man was admitted to our hospital in April 1996 for rapid onset of back pain. He was diagnosed with an acute dissection (Stanford type A) and an aortic regurgitation (grade 3/4). The aortic root was slightly dilated about 45 mm in diameter and the descending aorta was within a normal range of about 35 mm in diameter. There was no dissection at aortic root, so we performed aortic valve replacement and the ascending aortic replacement (Wheat procedure) with a 25 mm Carbo Medicus prosthetic valve and a 30 mm Hemashield prosthetic graft in emergency. The postoperative course was uneventful and postoperative examination demonstrated a good surgical result. The patient was followed up by computed tomog-

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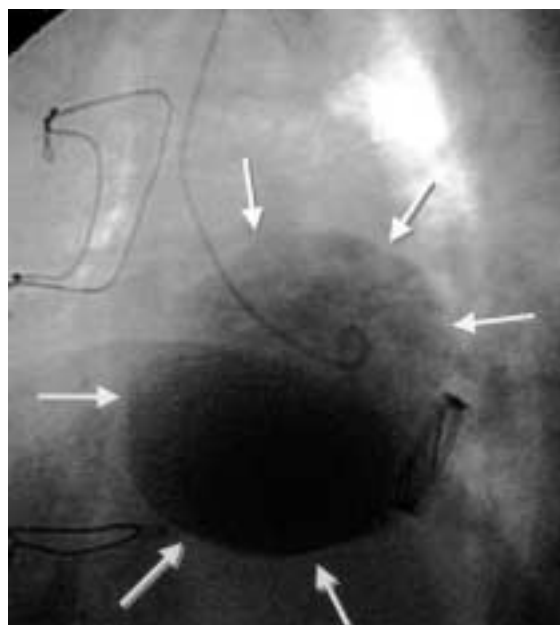
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**Fig. 1.** Preoperative chest enhanced computed tomography (CT).

- a: Chest enhanced computed tomography showed an aortic aneurysm about 60 mm in diameter.
- b: Chest enhanced computed tomography showed a thoracic aortic aneurysm about 70 mm in diameter.

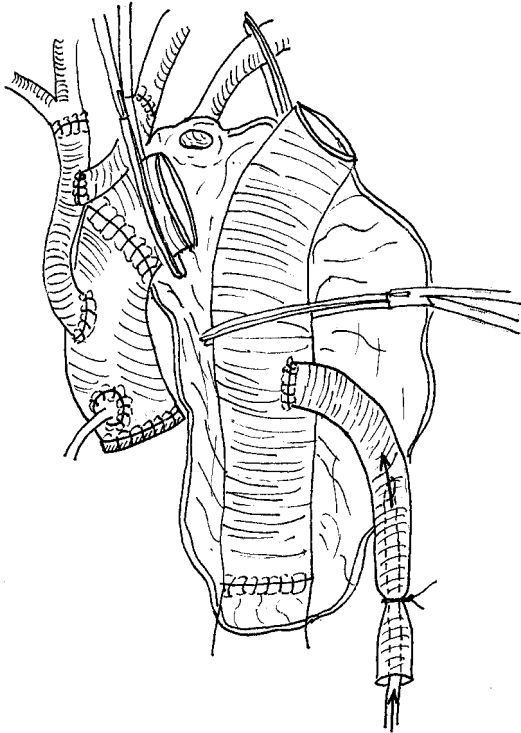
raphy (CT) each 6 months. He required no medication other than depressors. In July 1999, 40 months after the initial operation, although he had no symptoms, a follow-up computed tomography showed an aortic root aneurysm about 60 mm in diameter, a thoracic aortic aneurysm about 70 mm in diameter and chronic aortic dissection from the aortic arch to over the femoral artery but there was no abdominal aortic aneurysm (Fig. 1). Immediate aortography was performed from the percutaneous route into the right radial artery and demonstrated a ball-like aortic root aneurysm 60 mm in diameter and chronic aortic dissection (Fig. 2). We decided to perform composite graft replacement and aortic replacement from the aortic arch to the descending aorta, at a high level, at about T7. A second median sternotomy was done, and the aneurysm was carefully dissected off the sternum. Cardiopulmonary bypass was instituted with an arterial cannula in the ascending aorta and a single two-stage cannula for venous return in the right atrium. The left side of the heart was vented through the right superior pulmonary vein. There was chronic dissection at the femoral artery, so we could not institute an arterial cannula in the femoral artery. On cardiopulmonary bypass, the prosthetic valve was well seated and no clot deposition or perivalvular leak, so the prosthetic valve was left. The aortic root aneurysm and the ascending aortic graft were incised and replaced with a 30 mm Hemashield graft, and the coronary arteries were directly anastomosed using a Carrel patch



**Fig. 2.** Preoperative aortography.

Preoperative aortography demonstrated an aortic root aneurysm that looked like a ball.

method. Further, the innominate artery and the left common carotid artery were replaced by 12 mm, and 10 mm Hemashield grafts during selective cerebral perfusion. Aortic clamping time was 247 minutes, right selective cerebral perfusion was 8 minutes and left selective cerebral perfusion was 22 minutes. After the operation, the patient had slight liver dysfunction and a rash that were

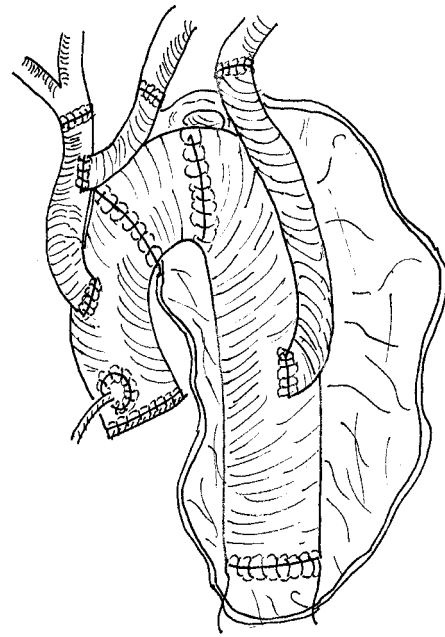


**Fig. 3.** After completion of the distal anastomosis, distal aortic perfusion was started by percutaneous cardiopulmonary support (PCPS) with an arterial cannula in the 10 mm Hemashield branch and venous cannula in the femoral vein.

caused by homologous blood transfusion. Ten weeks later, the patient got better and we performed the descending aorta replacement. The fourth intercostal thoracotomy was performed. The distal descending aorta was crossclamped with two clamps and replaced with a 32 mm Hemashield graft with a 10 mm Hemashield branch. After completion of the distal anastomosis, distal aortic perfusion was started by percutaneous cardiopulmonary support (PCPS) with an arterial cannula in the 10 mm Hemashield branch and venous cannula in the femoral vein (Fig. 3). After completion of the proximal anastomosis, PCPS was turned off and the left subclavian artery was replaced with the 10 mm Hemashield branch (Fig. 4). Histological finding of the aortic wall showed cystic medial necrosis in some places, but no inflammatory response or arteriosclerosis (Fig. 5). He did well post operatively and had no neurological complications. He was discharged 20 days after the third operation.

### Discussion

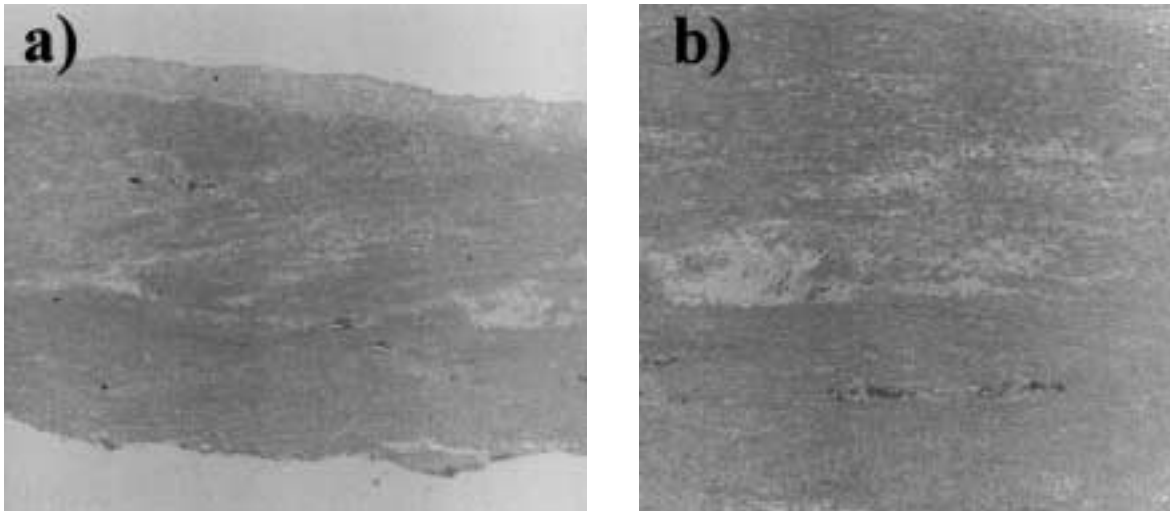
In 1964 Wheat et al.<sup>4)</sup> reported the successful repair of an aneurysm of the ascending aorta and concomitant aortic



**Fig. 4.** Final reconstruction including Bentall, arch repair and descending aortic replacement.

valve replacement (AVR) is called the Wheat procedure, but the method has been thought to have less merits than the composite method since a remnant of the aortic root can develop into late aortic root aneurysm and aortic dissection. Symbas et al.<sup>5)</sup> reported the case of one patient with Marfan's syndrome who developed a dissecting aneurysm in the remaining aortic root 2 years following ascending aortic aneurysm resection and AVR. Some authors<sup>6-8)</sup> suggested that the composite method is most effective for annuloaortic ectasia (AAE) due to Marfan's syndrome, and the Wheat procedure is more effective for atherosclerosis aneurysm, acute and chronic dissecting aneurysm. Also Ergin et al.<sup>9)</sup> suggested that the current criterion for surgery of aortic root replacement should be over 4.8 cm of dilated ascending aorta in aortic regurgitation patients with aortic degenerative valve. Kim et al.<sup>10)</sup> reported that hypertension was related to dilation of the ascending aorta and aortic root.

In our case, the aortic root showed slight dilation (45 mm) and there was no dissection at the aortic root, so we performed the Wheat procedure. However the cause of aortic root aneurysm after the Wheat procedure was considered to be poor hypertensive control during the post-operative follow-up, slight dilation of the aortic root at first operation, and weakness of the aortic wall due to



**Fig. 5.** Histological findings of the aortic wall of aneurysm.

Histological findings of the aortic wall of aneurysm showed cystic medial necrosis in some places, but no inflammatory response nor arteriosclerosis (a:  $\times 20$ , b:  $\times 40$ ).

pathological changes of cystic medial necrosis.

McCready et al.<sup>11)</sup> reported that there were no significant differences between complications (arrhythmias, bleeding, embolic episodes, congestive heart failure, myocardial infarction and recurrent aneurysms of aortic root) and mortality after the Bentall procedure and the Wheat procedure. The incidences of distal aneurysm formation and pericoronary false aneurysm in the Bentall procedure group were significantly higher than Wheat procedure group. We think that the Wheat procedure is advisable in cases with no collagen disease, Marfan's syndrome or aortitis, atherosclerosis aneurysm and acute and chronic dissecting aneurysm under 45 mm diameter.

However the Wheat procedure should be considered in cases with collagen disease, Marfan's syndrome or aortitis, when the ascending aortic aneurysm is over 45 mm in diameter and in poor hypertensive control patients.

Furthermore we could diagnose aortic root aneurysm by regular follow-up chest enhanced computed tomography (CT) and echocardiography. Therefore, the cases with slight dilation of the aortic root at the Wheat procedure should undergo regular follow-up evaluation by chest enhanced CT and echocardiography.

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